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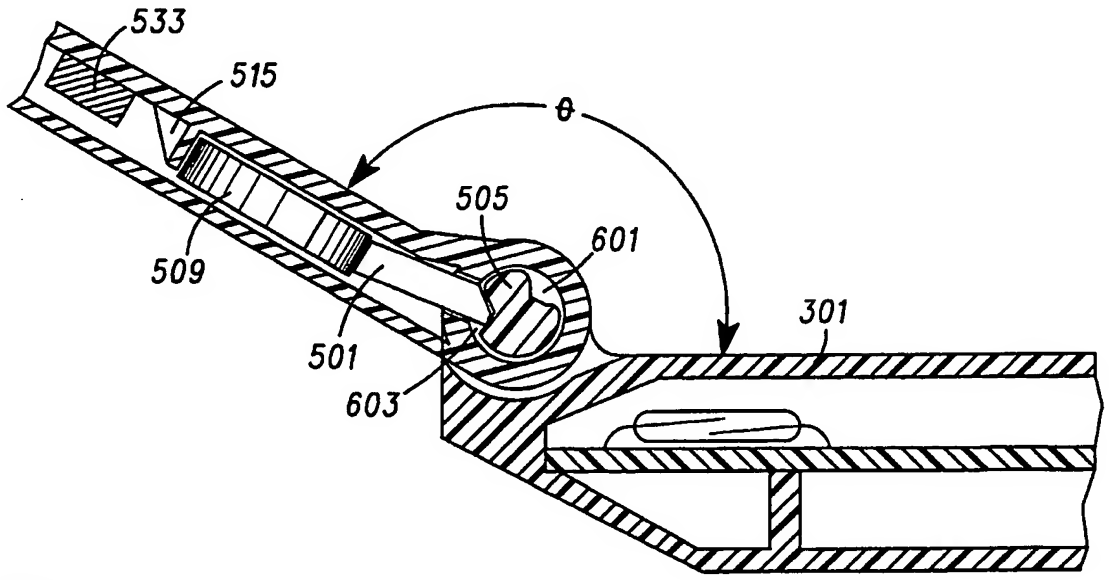

(57) Abstract

A hinge apparatus for a foldable telephone (300) includes a body portion (301) and a flip element (303). The flip element (303) is held in a closed and open position relative to the body portion (301) by an enclosed follower (501) which follows recesses (601 and 603) in a first hinge shaft (505). The recesses (601 and 603) are positioned relative to the follower (501) such that a torque of a force (F1 and F2) is applied to the hinge shaft (505) thereby resulting in a low profile flip element (303). Wires (531) dressed from the flip element (303) to the body portion (301) are protected from damage by an arm (805) pulling the wires (531) towards the center of second hinge shaft (527) and by allowing the second hinge shaft (527) to rotate with the flip element (303).

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HINGE APPARATUS FOR FOLDABLE RADIOTELEPHONES

Field of the Invention

This invention relates generally to hinged housings for miniature electronic equipment and more particularly to foldable radiotelephones which utilize hinged housings for folding elements.

Background of the Invention

Portable, cellular phones are increasingly utilized to permit a user to communicate telephonically over a wireless system at virtually any location. The portable telephone transmits a low wattage, radio frequency signal to a receiving station whereat connections are provided with conventional telephone systems. Numerous receiving stations are spaced apart at fixed locations in an area to receive the signals transmitted by the portable telephone as the portable telephone is relocated throughout the area.

Telephones utilizing two housing elements connected with some type of hinging mechanism, are common in wireline telephone sets and landline wireless extension phones and have become more common in portable cellular radiotelephones. This folding arrangement allows for the telephone to be more compact when the two housings are folded upon themselves.

Some radiotelephones which utilize this type of design have most of the electronics within the larger of the two housings. The smaller housing, which will be

called the flip element hereinafter, normally contains the microphone and the ringing element. For good acoustical performance, the flip element must be held in an optimum position relative to the body of the radiotelephone. In doing so, the microphone is positioned a desired distance from the user's mouth. Because the microphone and ringing element must make electrical connection to the electronics within the body of the radiotelephone, a means of connection through the hinge area is needed. Such connection was described in U.S. Patent No. 4,897,873 as shown in FIG. 1. The microphone and ringing elements within the flip element portion 101 are connected to electrical components within the body portion 103 via wire 105 which pass through the hinge knuckle 107, through a slot 109 in the shaft 111 and then into the body portion 103. The hinge shaft 111 is secured to the body portion 103 such that the hinge knuckle 107 of the flip element 101 may rotate about the shaft 111. A serious problem with this design is that the wire 105 gets pinched between the hinge shaft 111 and an inside surface of the hinge knuckle 107 as the flip element 101 rotates. The pinching force eventually breaks the wire causing loss of electrical contact to either the microphone or the ringing elements located within the flip element portion 101.

Other radiotelephones which utilize this type of design have all the electronics within the larger of the two housings. The flip element contains no electronics. A flip element of this sort may have the capability of producing an on-hook condition when the flip element is in the "closed" position and an off-hook condition when the flip element is rotated to its "opened" position. A radiotelephone which employs the position of the flip element for control purposes was described in U.S. Patent No. 4,845,772. When the flip element is in its "closed"

position the radiotelephone is in a standby state ready to receive an incoming call. The flip element covers at least a portion of the keypad on the body of the radiotelephone thereby shielding the keys to avoid accidental key depression or contamination of the keys with foreign material. When the flip element is in the "opened" position, some background noise is shielded from the microphone by the flip element.

A variety of techniques have been used to position the flip element in the closed and open position. A radiotelephone which holds the flip element in the closed and open position using an enclosed cam element which follows recesses in one shaft securing the hinge elements was described in U.S. Patent No. 4,897,873. A detailed view of the cam mechanism can be seen in FIGS. 2A and 2B. FIG. 2A illustrates the position of recesses 201 and 203 when the flip element 101 is in the closed, on-hook, position. FIG. 2B illustrates the position of the recesses when the flip element is in the open, off-hook, position. When opening the flip element 101, a cam detent 205 moves out of recess 203 in hinge shaft 207 and onto the full diameter surface of the hinge shaft 207. A spring 209 placed between a wall 211 and the detent cam 205 constantly forces the detent cam 205 against the shaft 207. As the flip element continues to rotate to the open or off-hook condition, the detent cam 205 continues to push against the shaft 207 and then force itself into the recess 201. The force of the detent cam 205 in the recess 201 holds the flip element portion 101 in the desired position. When the flip element 101 is in both the open and closed position, the detent cam 205 is projected directly towards the center of the hinge shaft 207. Since the center of the hinge shaft 207 is offset from the plane of the flip element 101 the detent cam 205 must be angularly

positioned. The angular position of the detent cam 205 respective to the plane of the flip element 101 limits the thickness 215 of the flip element 101. Increased miniaturization of radiotelephones allow the radiotelephones to be packaged in housings of even smaller dimensions. The hinge assembly described hereinabove are of dimensions which limits further decrease in the thickness 215 of the flip element 101 .

Therefore, a hinge assembly design is required which protects the wire which passes through the hinge knuckle from the flip element to the body as well as resulting in a flip element having smaller dimensions.

Summary of the Invention

A hinge apparatus for a foldable radiotelephone apparatus has a body portion and a flip element portion. The hinge apparatus is capable of maintaining the flip element portion in a first position of rotation relative to the body portion. An essentially cylindrical hinge shaft, having a circumferential surface and a diametric, rotatably couples the flip element portion to the body portion about an axis of rotation through the diametric center. The cylindrical hinge shaft is prevented from rotating relative to the body portion. A recess is disposed in the circumferential surface. A follower is disposed at least partially within the flip element portion and has an end portion disposed in the recess. The follower exerts a force on the cylindrical hinge shaft along a line of action essentially parallel to the axis of the follower and at a perpendicular distance between the line of action and the axis of rotation whereby a torque on the cylindrical hinge shaft is produced when the flip element portion in the first position.

Brief Description of the Drawings

FIG. 1 shows a conventional technique of connecting the wire from the ringing element and microphone in the flip element to the body.

FIGS. 2A and 2B are cut-away side views of a conventional cam mechanism where the flip element is shown in both the closed and open position, respectively.

FIG. 3 is an isometric drawing of a portable radiotelephone which may employ the present invention.

FIG. 4 is a side view of the radiotelephone where the flip element is nearing the closed position.

FIG. 5 is an exploded view of the body portion and the flip element illustrating the hinge assembly of the radiotelephone shown in FIG. 3.

FIG. 5A is a cut-away view, of the hinge cavity portion of the body showing a round aperture disposed in an upstanding rib.

FIG. 5B is an isometric view of the bottom side of the hinge shaft and hinge knuckle shown in FIG. 5.

FIGS. 6A and 6B are cut-away side views of the detent hinge mechanism where the flip element is shown in both the closed and open positions, respectively.

FIG. 7 is a more detailed end-view of the hinge shaft illustrated in FIGS. 6A and 6B.

FIG. 8 shows the means of connecting the wires from the the microphone in the flip element to the body.

FIG. 9 is a cross-sectional view of the hinge portion of the radiotelephone along the hinge axis.

Brief Description of the Preferred Embodiment

A portable radiotelephone adapted for use in a radiotelephone system is shown in FIG. 3. This portable unit 300 consists basically of two readily apparent portions, a body portion 301 and a flip element portion 303. The drawing of FIG. 3 shows the flip element in an "open" position such that a user of the portable unit may listen via earpiece 305 and may speak into the microphone 307. The keypad 309 consists of a plurality of buttons numbered one through zero, #, and *, in a familiar telephone arrangement. The keypad 309 may also have additional functions buttons such as volume control and other buttons associated with telephone number recall. An antenna 311 enables wireless communication between the portable unit and a base station.

When the flip element 303 is open as shown in FIG. 3, the portable cordless telephone can be in a state of answering or making a telephone call. Such a state is commonly known as "off-hook". Upon completion of a telephone call, the user may hang up the portable unit by moving the flip element into a closed position. This hanging-up may be accomplished by causing the flip element 303 to rotate about the axis of the hinge portion 312 so that the flip element 303 rests against the keypad 309. This action activates a "hook-switch" which causes the telephone call to be terminated. In the closed position the portable unit is in a standby state ready to receive an incoming call. The closing of the flip element 303 can best be perceived in FIG. 4. The hook switch in the preferred embodiment is located within the flip element 303. Activation of the hook switch occurs in the preferred embodiment when the angle between the body 301 and the flip element 303 equals approximately 45°.

In the preferred embodiment, the flip element 303 is held in the open or closed position by a combination of elements shown in FIG. 5. A detent follower 501 is placed within a hinge knuckle 503 and forced against the cylindrical hinge shaft 505 by a resilient medium such as a spring 509. The spring 509 is formed from the flat curved piece of steel having a first end 511 hooked against a protrusion 513 in the flip element 303. The center portion of the spring 509 presses against a post 515 such that the second end of the spring 517 forces the detent follower 501 through an aperture 519 into a hinge knuckle 503. The design of the hinge shaft 505 allows the flip element 303 to be held against the keypad 109 in the on-hook or closed position and at an obtuse angle (for example, Θ equals 150°) in the off-hook or open position. One end 521 of the hinge shaft 505 has an elongated shape which fits into a slightly larger aperture 523 having essentially the same shape in a front housing portion 525 of the body 301. Thus, the rotation of the hinge shaft 505 is stationary with respect to the front housing portion 525 about which the hinge knuckle 503 may rotate.

A second hinge shaft 527 disposed within a second hinge knuckle 529 helps support the rotation of the flip element 303 while providing a means for dressing wires 531 attached to a microphone 533 from the flip element 303 to the body. The magnet 801 within the flip element generates a control signal in the body responsive to the rotational position of the flip element 303. A cover 535 conceals the spring 509, the microphone 533 and its wires 531 and the magnet 801 within the flip element 303.

A clip 550 is placed within the center knuckle 552 to prevent the shafts 527 and 505 from sliding out of their respective hinge knuckles 529 and 503.

FIG. 5A shows a cross sectional view, of the front housing portion 525. A round aperture 537 is disposed through an upstanding rib 539. A cylindrical end portion 541 of the hinge shaft 527 shown in FIG. 5, is disposed within the round aperture 537. Thus, the hinge shaft 527 is allowed to rotate with respect to the front housing portion 525.

FIG. 5B shows another side of the hinge shaft 527 illustrated in FIG. 5A. The hinge shaft 527 has a three sided channel 543 extending a predetermined depth into the channel 527 along the shaft's entire length. The hinge knuckle 529 has a three sided guide rail 545 disposed on the inside surface of the hinge knuckle and extending a predetermined distance along the knuckle's length. The hinge shaft 527 is inserted within the hinge knuckle 529 such that the guide rail 545 is disposed in the channel 543 thereby interlocking the hinge shaft 527 to the hinge knuckle 529. The hinge shaft 527 is now able to rotate about its axis with the rotation of the flip element 303. The interlocking feature of the hinge shaft 527 to the hinge knuckle 529 overcomes the problem encountered in the prior art (FIG. 1) wherein the wire is pinched as the hinge knuckle rotates about the shaft.

A more detailed view of the detenting hinge apparatus is illustrated in FIG. 6A and FIG. 6B. FIG. 6A illustrates the position of recesses 601 and 603, relative to the detent follower 501, when the flip element 103 is in the closed, on-hook position. FIG. 6B illustrates the position of the recesses 601 and 603, relative to the detent follower 501, when the flip element is in the open, off-hook position. When opening the flip element 303, the detent follower 501 moves out of recess 601 in the hinge shaft 505 and onto the full diameter surface of the shaft 505. The spring 509 constantly forces the detent follower

501 against the hinge shaft 505. As the flip element continues to rotate to the open or off-hook condition, the detent follower 501 continues to push against the hinge shaft 505 and then forces itself into the recess 603. The force of the detent follower 501 in the recess 603 holds the flip element 303 in the desired position.

A primary feature of the preferred embodiment of the present invention is that the detent follower 501 exerts a torque of a force on the hinge shaft 505 about its center axis when the flip element is in both its closed and open position. The torque of the force on the hinge shaft 505 is created by angularly disposing recesses 601 and 603 such that the detent follower 501 does not project through the center of the hinge shaft 505. The advantage of this design approach allows the detent follower 501 to be disposed in or near the same plane as the flip element 303 whereby a thinner flip element may be utilized. In the preferred embodiment, the detent follower 501 is disposed at an small angle Ψ ,for example 10°, with respect to the plane of the flip element 303 to facilitate molding of the slot 519 in which the detent follower 501 is located. Alternate embodiments, having different molding considerations, may afford the opportunity of placing the detent follower 501 in the same plane as the flip element 303. A thin flip element contributes to the weight reduction of the portable unit. This primary feature overcomes the aforementioned prior art conditions contributing to the greater thickness of the flip element previously described in FIGS. 2A and 2B.

Now referring to FIG. 7, there is shown a more detailed view of the end of the hinge shaft 505 shown in FIGS. 6A and 6B. Recess 601 has two essentially planar surfaces 701 and 703 in which the planes of the surfaces intersect to form an angle. The detent follower 501 has

two essentially planar surfaces 705 and 707 which contact planar surfaces 701 and 703, respectively, in the recess 601 when the flip element 303 is in the closed, on-hook position. A primary torque of a force, F1, exerted between the planar surface 701 of recess 601 and the planar surface 705 of the detent follower 501, relative to the center axis of the hinge shaft 505, preloads the flip element 303 thereby maintaining the flip element in its closed position.

Recess 603 also has two essentially planar surfaces 709 and 711. The detent follower 501 has two essentially planar surfaces 713 and 715 which contact the planar surfaces 709 and 711, respectively, of recess 603 when the flip element is in its open, off-hook, position. A primary torque of a force, F2, is applied between the planar surface 709 of the recess 603 and the planar surface 713 of the detent follower 501, relative to the center axis of the hinge shaft 505, thereby maintaining the flip element in its open position.

The imaginary planes formed by surface 701 of recess 601 and surface 711 of recess 603 intersect in an acute angle, Φ, which is related to the angle of the flip element 303 opening Θ. In the preferred embodiment the two angles, Φ and Θ, sum to approximately 180° when the flip element 303 is in the open position as shown in FIG. 6B. The design of the hinge shaft 505 allows the flip element 303 to open or close without further assistance when it is within 45° of either position. The flip element also has the ability to over travel the open position by an amount such as 30°, if forced, and return to the open position automatically when the force is removed.

FIG. 8 shows an end view of the microphone wires protected within the hinge knuckle. The wires 531 of the microphone 533 are pulled towards the center of the hinge

shaft 527 by an arm 805. An advantage of the preferred embodiment of the present invention is that wires 531 positioned near the center of the hinge shaft 527 undergo less rotational travel as the flip element is rotated thereby minimizing a twisting force placed on the wires.

The hook switch in the preferred embodiment is located within the flip element 303 and can be seen in FIG. 8. Activation of the hook switch occurs in the preferred embodiment when the angle between the body 301 and the flip element 303 equals approximately 45°. A conventional magnet 801 is placed in a position within the flip element 303. A conventional reed switch 803 is placed in a position within the body 301 essentially opposite the magnet 801. As the flip element 303 rotates about the axis of the hinge portion to its closed position, a magnetic field produced by the magnet 801 closes the contacts within the reed switch 803 thereby generating a control signal indicating the on-hook condition. When the flip element 303 rotates about the hinge portion 312 to its open position, the magnetic field created by the magnet 801 is removed from the proximity of the reed switch 803 allowing the reed switch contacts to open thereby generating a control signal indicating the off-hook condition.

In the preferred embodiment the housing of the body 301 is assembled from two parts shown in FIG. 5 as a rear housing 551 and a front housing 525. FIG. 9 shows a cross sectional view of the hinge portion after the elements of FIG. 5 are assembled. The flip element 303 is connected to the body by the hinge shafts 505 and 527 mentioned above. When the rear housing 551 of the body 301 and the front housing 525 of the body are snapped together, the ribs 901 and 903 of the rear housing 551 nest within the ribs 539 and 524, respectively, in the front housing. Apertures in

the ribs 901 and 903 of the rear housing align themselves concentrically with corresponding apertures 537 and 523 in the front housing 525. The shafts 527 and 505 push through the holes in their respective hinge knuckles 529 and 503, through the holes in the ribs of the front and rear housings. The clip 550 is then placed within the center knuckle 552 to prevent the shafts 527 and 505 from sliding out. In the preferred embodiment the shafts may only be removed when the flip element is in the closed position.

Therefore, a hinge mechanism for a radiotelephone has been shown and described. This novel apparatus results in a thinner flip element advantageously reducing the weight of the portable unit and dresses the wires from the flip element to the body eliminating broken wires and minimizing rotational stress.

What is claimed is:

Claims

1. A hinge apparatus for a foldable radiotelephone apparatus having a body portion and a flip element portion, the hinge apparatus capable of maintaining the flip element portion in at least a first position of rotation relative to the body portion, the hinge apparatus comprising:

an essentially cylindrical hinge shaft, having a circumferential surface and a diametric center, rotatably coupling the flip element portion to the body portion about an axis of rotation through the diametric center;

means for preventing the rotation of said cylindrical hinge shaft relative to the body portion;

a first recess disposed in the circumferential surface; and

a follower disposed at least partially within the flip element portion and having an end portion at least partially disposed in the first recess, the follower exerting a first force on said cylindrical hinge shaft along a first line of action essentially parallel to the axis of the follower and at a first perpendicular distance between the first line of action and the axis of rotation whereby a first torque on said cylindrical hinge shaft is produced when the flip element portion is in the first position.

2. A hinge apparatus for a foldable radiotelephone apparatus in accordance with claim 1 wherein said means for preventing further comprises:

an elongated end portion of said cylindrical hinge shaft;

a rib disposed within said body portion and having an elongated aperture disposed therein, said elongated aperture being larger than said elongated end portion and essentially the same shape as said elongated end portion, said elongated end portion is disposed within said elongated aperture thereby preventing the rotation of said cylindrical hinge shaft relative to the body portion.

3. A hinge apparatus for a foldable radiotelephone apparatus in accordance with claim 1 wherein said force exerted by said follower is generated by a flat spring, disposed within the flip element portion, pressing on said follower.

4. A hinge apparatus in accordance with claim 1 wherein the hinge apparatus is capable of maintaining the flip element in a second position of rotation relative to the body portion of the radiotelephone, the hinge apparatus further comprising a second recess disposed in the circumferential surface, the end portion of the follower at least partially disposed in the second recess, the follower exerting a second force on said cylindrical hinge shaft along a second line of action essentially parallel to the axis of the follower and at a second perpendicular distance between the second line of action and the axis of rotation whereby a second torque on the cylindrical hinge shaft is produced when the flip element portion is in the second position.

5. A hinge apparatus in accordance with claim 1 wherein the flip element portion and the body portion have flexible conductive leads coupled therebetween the hinge apparatus further comprising:

a second essentially cylindrical hinge shaft, having a second circumferential surface, rotatably coupling the flip element portion to the body portion;

a recess disposed in the second circumferential surface and having a portion the flexible conductive leads disposed therein; and

means for rotating said second cylindrical hinge shaft relative to the rotation of the flip element portion.

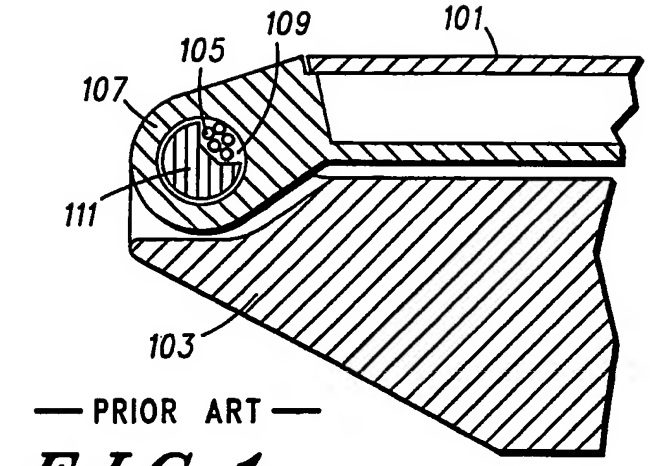
6. A hinge apparatus in accordance with claim 7 further comprising means for confining said flexible conductive leads at least partially within said recess thereby reducing the rotational travel of the flexible conductive leads as the flip element rotates.

7. A hinge apparatus in accordance with claim 1 wherein the flip element portion includes at least one electrical element having at least one flexible conductive lead, the body portion includes circuitry coupled to the flexible conductive lead for sending an electrical signal to the electrical element, the hinge apparatus further comprising:

a second cylindrical hinge shaft rotatably coupling the flip element portion to the body portion;

a recess disposed on a cylindrical surface of said second cylindrical hinge shaft wherein the flexible conductive lead is routed from the flip element portion to the body portion; and

means for rotating said second cylindrical hinge shaft relative to the rotation of the flip element portion.

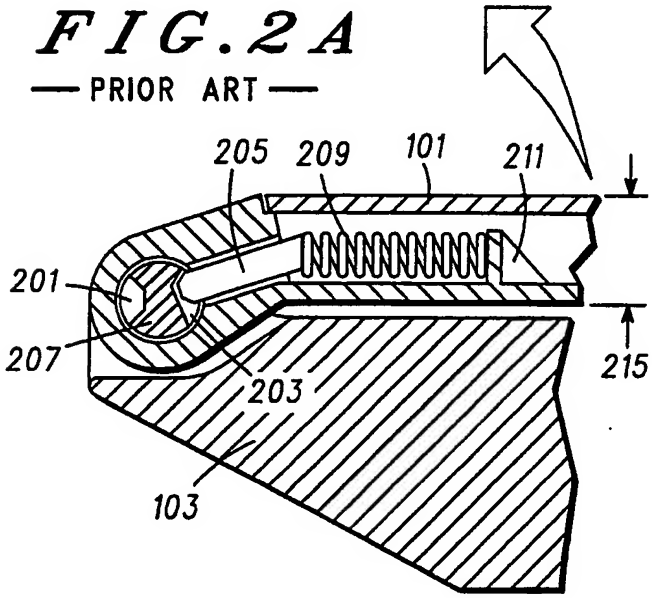


— PRIOR ART —

FIG. 1

FIG. 2A

— PRIOR ART —



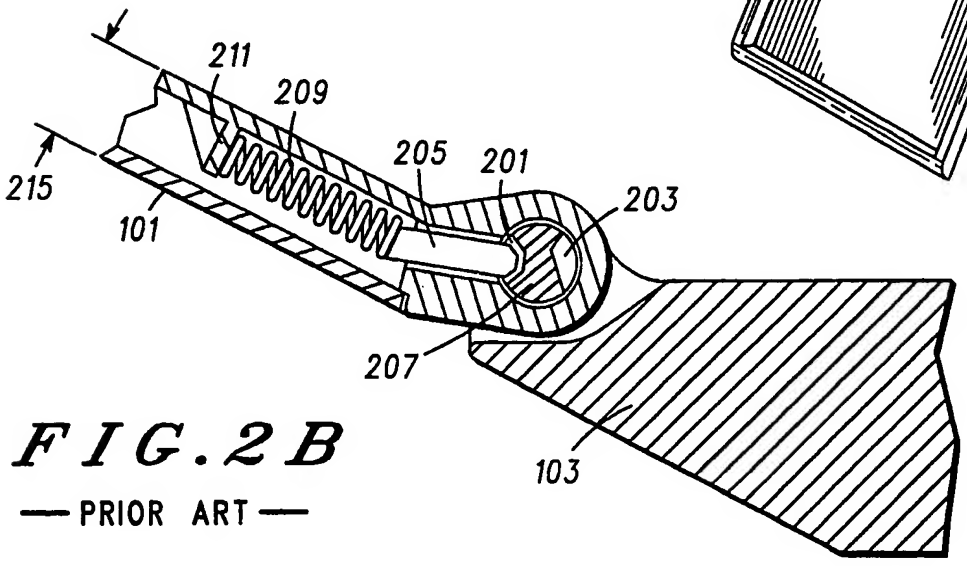


FIG. 2B

— PRIOR ART —

FIG. 3

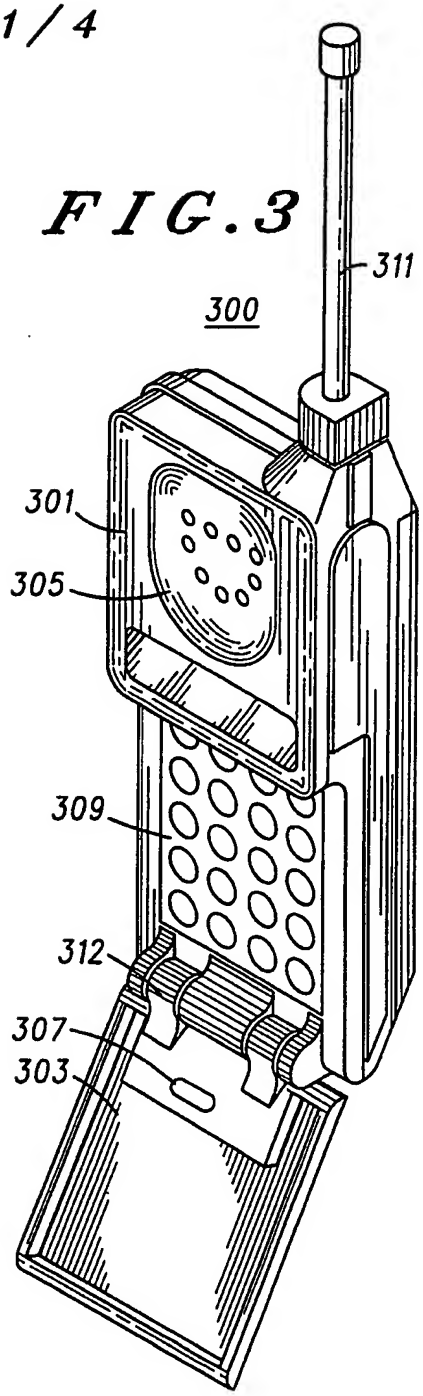
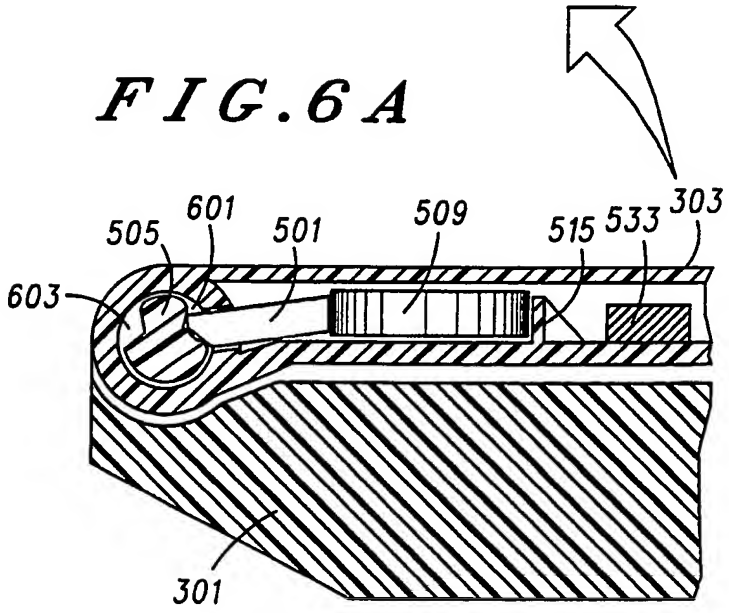


FIG. 6A



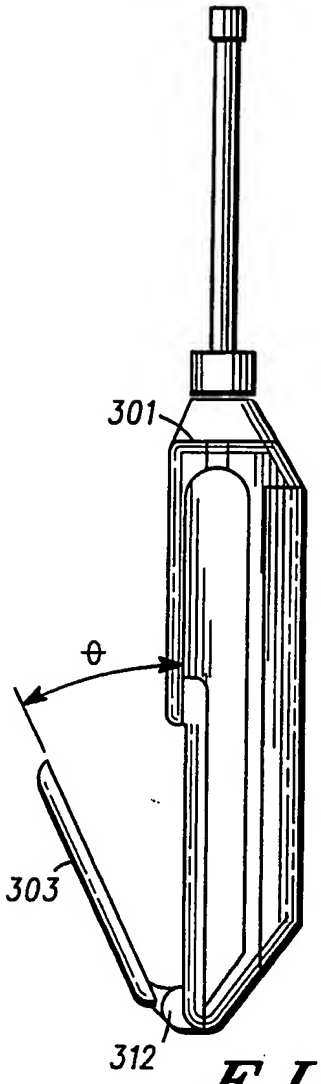
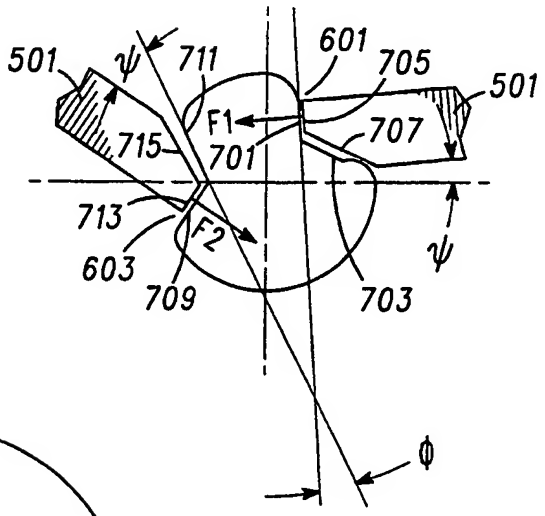


FIG. 4

FIG. 7



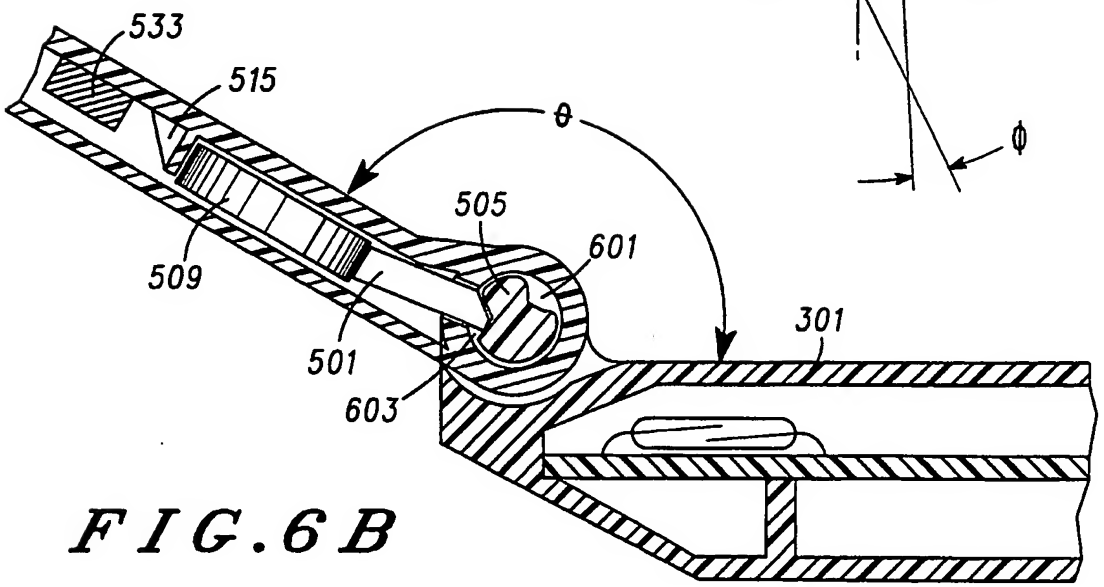


FIG. 6B

FIG. 5A

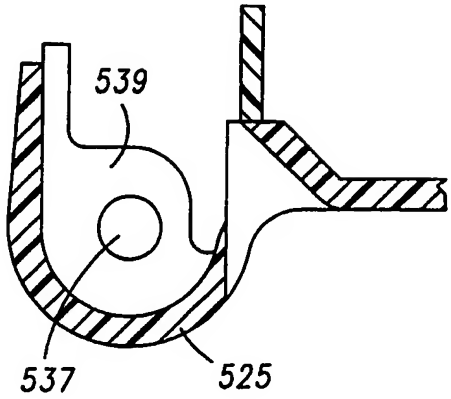


FIG. 5B

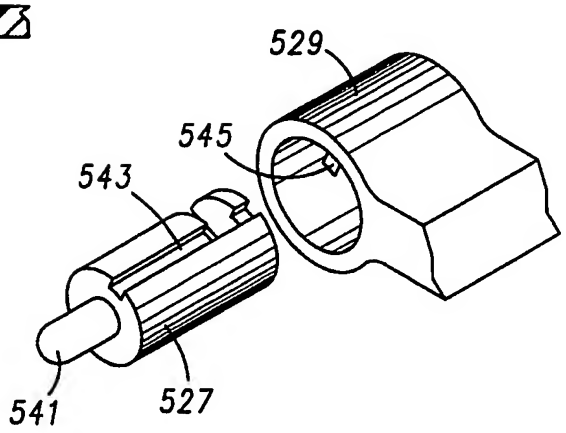
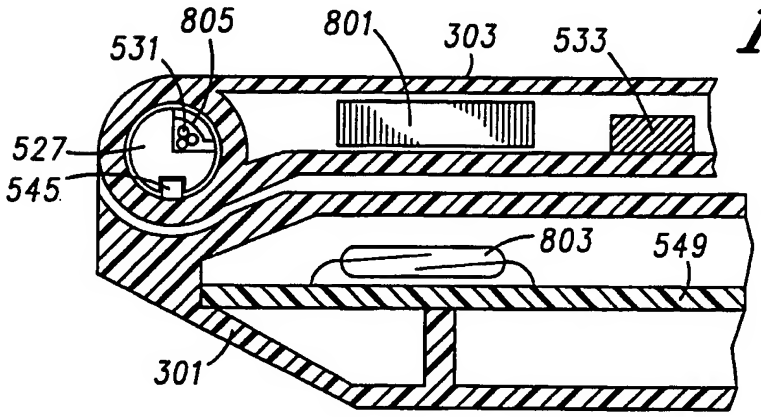


FIG. 8



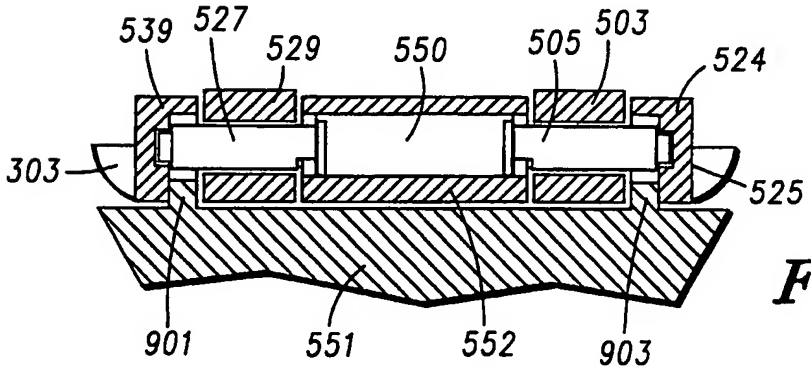


FIG. 9

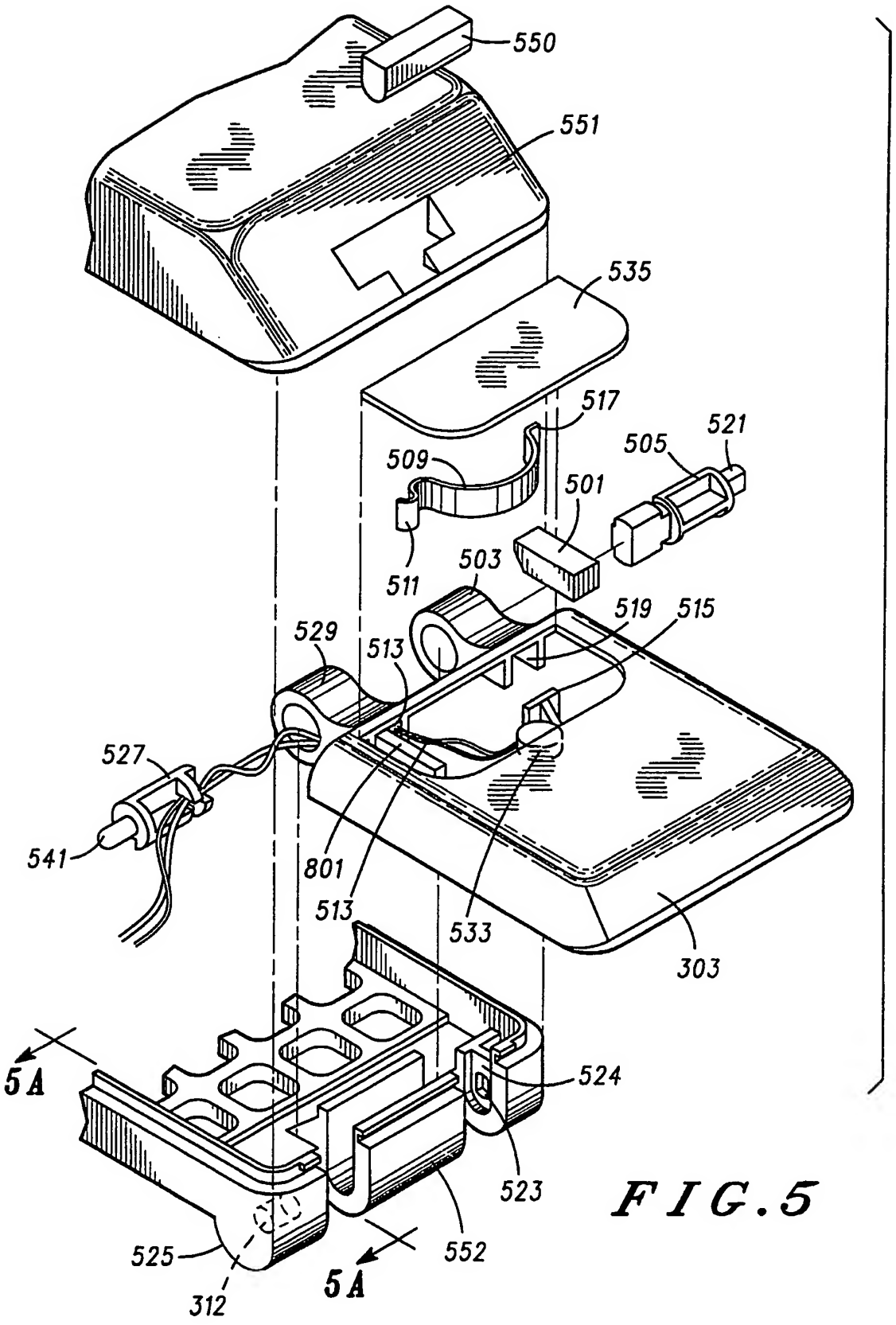

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FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/01718

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04M 1/00
US CL :379/433; 16/321, 334

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. :

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,897,873 (BEUTLER ET AL) 30 January 1990, See figures 3, 5a, 5b, 7 and columns 3, 4.	1-7
A	US, A, 4,424,606 (SORIMACHI) 10 January 1984, See entire document.	1-7
A	EP, A, 0220579 (MANZALINI) 06 May 1987, See entire document.	1-7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

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Date of the actual completion of the international search	Date of mailing of the international search report
14 JULY 1992	12 AUG 1992
Name and mailing address of the ISA/ Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer HUYEN LEE Telephone No. (703) 305-4844

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